New Release

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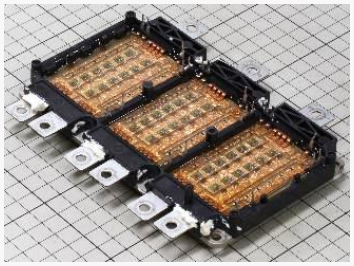
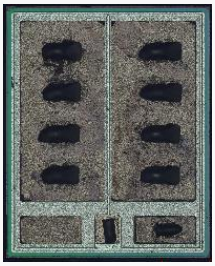
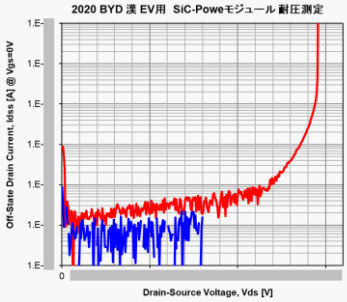
BYD Han EV (2020) rear inverter SiC power module: Structure analysis and MOSFET process analysis reports



Module appearance



SiC MOSFET Die



SiC MOSFET Idss-vs-Vds

Product Summary

Model number: BM840F12B34U2 3-Phase Motor Inverter Module

- In-vehicle SiC power module used for the first time in the rear inverter of BYD Han EV (released in China in July 2020)
- Inverter specifications: Maximum output 200kW, Rated voltage: 570V, Current: 420Arms
- Die size: 4.32 mm x 5.32 mm, Trench type MOSFET

Reports Content

◆ **SiC power module structure analysis report.** Report price: US7,500 (100 pages)

1. BYD's in-vehicle module that uses single-sided cooling (PinFin).
   * Sintered Ag is used for the die attach between the die and the module electrode.
2. Adopted a multi-die configuration using 6 MOSFETs per 1 switch.
   * Possible countermeasure against low manufacturing yield ?
3. The SiC- MOSFET uses a trench gate structure.

◆ **SiC MOSFET process analysis report.** Report price: US$7,500 (35 pages)

1. Conducted electrical characteristics (static characteristics) evaluation.
   * The maximum operating voltage of this product is 1200V.
   * This MOSFET features the lowest Idss compared with others SiC devices.
   * Specific RonA is about the same as the 3rd gen SiC MOSFETs of major manufacturers (INFINEON etc.)
2. Estimate the impurity concentration of the N-Epi layer and analysis of the ON resistance components from the structure and electrical evaluation.
3. Considerations of particular structural features.
   Extraction of manufacturing process flow and estimation of the number of masks.

Note: The report price may change over time. For current price contact **info@ltecusa.com**.

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Excerpt from SiC Power Module Structural Analysis Report (1)

Content

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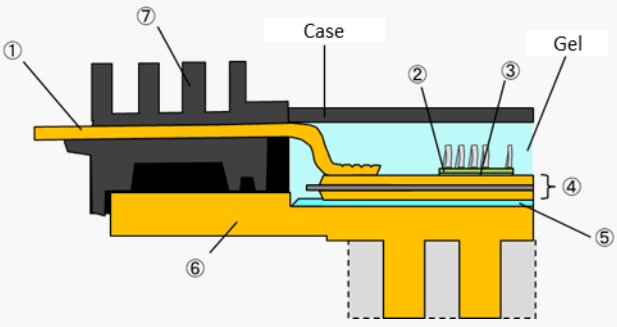
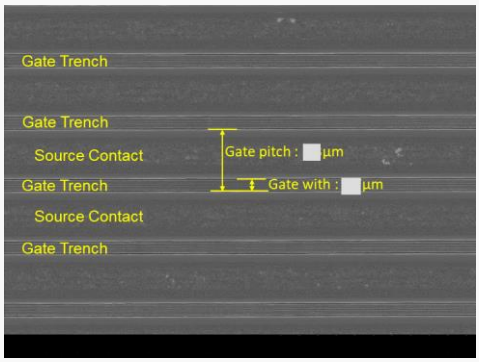
Excerpt from SiC Power Module Structural Analysis Report (2)

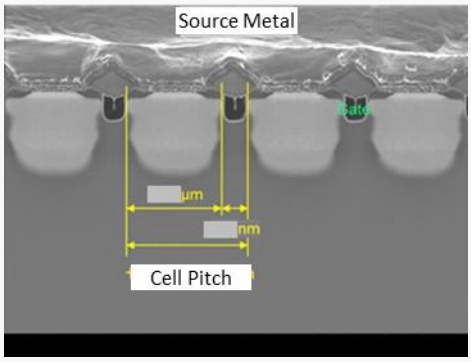


Module structure schematic diagram

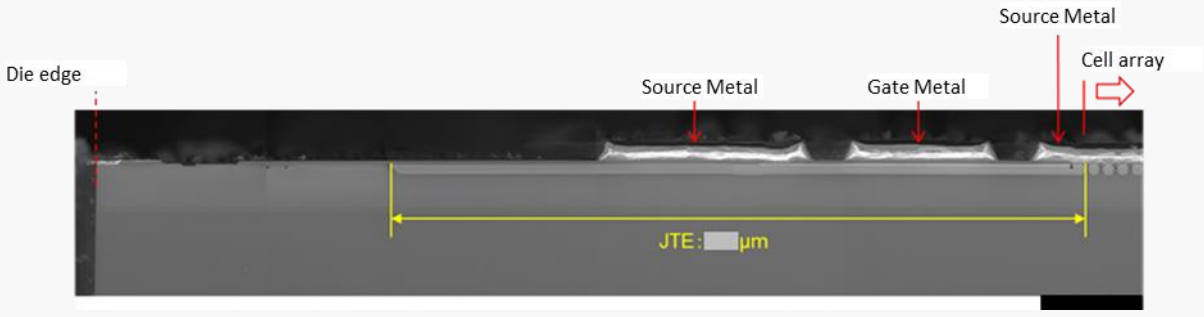
#	Measured Part		Thickness	Material
1	Terminal		1010μm	Cu
2	SiC-MOSFET			
2-1		Bonding wires (Source)		
2-2		Bonding wires (Gate)		
2-3		Top surface protection film		
2-4		Top surface metal		
2-5		Semiconductor substrate		
2-6		Backside metal-1		
2-7		Backside metal-2		
2-8		Backside metal-3		
2-9		Backside metal-4		
3	Die Attach			
4	AMC Power substrate			
4-1		AMC Upper metal		
4-2		Dielectric		
4-3		AMC Lower metal		
5	Solder			
6	Heat Cooler			
6-1		Ni plated layer		
6-2		Base plate		
6-3		Heat sink Pin length		
7	Case		-	C,Si,O,Mg,Al,Sb,Ca,S



Cell array plane SEM image (Poly-Si layer)



Transistor Cell array SEM image



Cross-section SEM image of the outer periphery of the die.

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Excerpt from SiC MOSFET Process Analysis Report (1)

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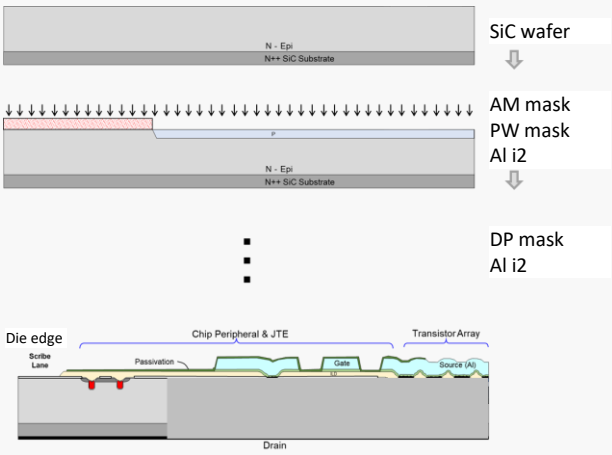
Excerpt from SiC MOSFET Process Analysis Report (2)

1-1. Comparison of BYD and other companies' SiC- MOSFETs

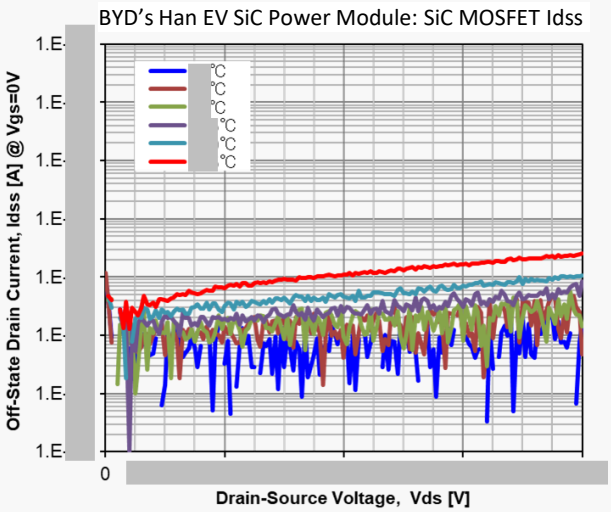
Maker	Part no.	Process Gen	Production	Vdss [V]	RON [mΩ]	Die Size [mm x mm]	Die Area [mm2]	Intrinsic RONxA [mΩ· mm2]
ROHM	SCT3080KL/HR	Gen 3	2016	1200	80	3.01x2.41	7.3	408
WOLFSPEED (CREE)	C3M0075120K	Gen 3	2017					
ON-SEMI	NVHL080N120SC1	Gen 1	2018					
INFINEON	FF11MR12W1M1_B1 IMW120R045M1	Gen 1	2017					
MICROSEMI	APT80SM120B	Gen 1						
MICROSEMI	MSC040SMA120B	Gen 2	2018					
LITTELFUSE	LSICMO120E0080	-	2017					
TOSHIBA	TW070J120B	Gen 1 *	2020					
DENSO	Toyota MIRAI FEC EV	Gen 1	2021					
BYD(?)	BYD's Han EV	—	2020					

*) With built-in Schottky Barrier Diode (SBD)

·Manufacturing process flow



·Electrical characterization



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